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Effect of relaxation exercises on dyspnea and sleep quality in chronic obstructive pulmonary disease

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ABSTRACT

Aim: Sleep disorders is one of the most common problems after respiratory symptoms in patients with COPD. The probability of sleep disorders increases at the same rate with the severity of COPD symptoms. The aim of our study is to evaluate the effect of relaxation exercises on dyspnea and sleep quality in COPD patients receiving optimal bronchodilator therapy.

Material and Method: This is a randomized controlled clinical study. The study was conducted with 67 voluntary patients with COPD who admitted to the Muğla Traininng and Research Hospital Chest Dieseases Outpatient Clinic. The study was planned as pretest and posttest clinical trial which included COPD patients with severe dyspnea and patients were randomly distributed to the intervention and control groups. Patients in the intervention group (n=34) were given relaxation exercises to be practiced at home for six weeks. Patients in the control group (n=33) were given breathing exercises. During this period, all patients continued to receive routine medical treatments. At baseline and after the intervention dypsnea and sleep quality was assessed.

Results: There was a significant decrease in the posttest Modified Borg Scale-MBS, Modified Medical Research Council Scale-mMRC medians ($p<0.001$) in intervention group. Additionally a significant improvement in Global Pittsburgh Sleep Quality Index (PSQI) ($p<0.001$) and also some sleep quality subscales including subjective sleep quality ($p<0.001$), sleep latency ($p=0.029$), sleep duration ($p<0.001$), sleep efficiency ($p=0.047$) and daytime dysfunction ($p<0.001$) were found in the intervention group.

Conclusion: We think that relaxation exercise, which is simple and an easy-to-apply method would provide a decrease in the dyspnea severity and an improvement in sleep quality of the patients with COPD when added to the optimal medical treatment.

Keywords: COPD, relaxation exercises, dyspnea, sleep quality

Our research's data was presented in 24. National Congress of Turkish Thoracic Society as 'E-poster Presentation' on November 2021.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is an is a preventable and treatable chronic inflammatory lung disease with permanent airflow limitation, airway and alveolar abnormalities (1). COPD is characterized by long-term respiratory symptoms. COPD is an increasing public health problem. It causes serious incapacity and economic burden in the societies where it is seen. As a result of airflow limitation in COPD, patients admit to hospitals with various symptoms such as shortness of breath, chronic cough, sputum, weakness and fatigue. Sleep disturbance is one of the most common symptoms reported by COPD patients (2). Sleep duration, effectiveness and quality may decrease due to the degree of dyspnea, which is the most important symptom in COPD. Sleep quality is often impaired in patients with COPD, which is likely to be an important factor in the chronic fatigue, sleepiness and overall impairment in quality of life reported by these patients (3).

The main purpose of the pharmacological treatment of COPD is improve a patient's functional status and quality of life by preserving optimal lung function, improving symptoms, and preventing the recurrence of exacerbations. Currently, none of the pharmacological treatments have been shown to significantly improve lung function or decrease mortality (4-7). There is an increasing interest in non-pharmacological treatment methods of COPD. Pulmonary rehabilitation is one of these non-pharmacological treatment methods in patients with COPD. Pulmonary rehabilitation is a central aspect of the treatment of COPD, for which treatment other than smoking cessation and long-term oxygen therapy largely aims at improving symptoms.

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Pulmonary rehabilitation is described as an 'individually tailored and designed, multidisciplinary programme of care' for patients with chronic respiratory impairment. The Global Initiative for Chronic Obstructive Disease suggests that pulmonary rehabilitation be included in the management of patients with chronic obstructive pulmonary disease (COPD) categories B, C, and D (1). Pulmonary rehabilitation programs in COPD are usually personalized programs (8). The best results come from 6-8 week programs those are performed in rehabilitation clinics. As an alternative to pulmonary rehabilitation, the relaxation exercises those can be done at home are used for the patients who can not require going to any special center.

In this study, we aimed to demonstrate the effectiveness of relaxation and breathing exercises on sleep related disorders in COPD patients with severe dyspnea who were under optimal bronchodilator treatment.

MATERIAL AND METHOD

For this study, the approval of Muğla University Faculty of Medicine Clinical Researches Ethics Committee (Date: 05.09.2019, Decision No: 11/VI) was received. All procedures were carried out in accordance with the with the ethical rules and the principles of the Declaration of Helsinki. This randomized controlled study was conducted with COPD patients who applied to the Chest Diseases Outpatient Clinic at Muğla Training and Research Hospital between September 2019–January 2020. The sample size was calculated by using G Power 3.1.9.4. Considering possible losses (10%), it was planned to reach approximately 72 COPD patients (36 patients for intervention and 36 patients for control). Dyspnea severity was assessed by Modified Medical Research Council (MMRC) Dyspnea Scale ≥2. Seventy eight COPD patients with high dyspnea score were interviewed between September 2019 and January 2020. The exclusion criterias were having hearing, neurological or psychological problems, presence of immunosuppressive state, oncological disease, decompensated heart failure or acute myocardial infarction. Also, the patients who participated another rehabilitation program were excluded. Six patients who did not meet the research criteria and did not want to participate were excluded from the study. Seventy two COPD patients of our outpatient clinic were included. The demographic data, smoking status, mMRC scores, spirometry parameters and oxygen saturation (SpO_2) were recorded. The participants were randomized 1:1 to either a supervised training intervention group (INT, n=37) or a control group (CON, n=35). The baseline Modified Borg Scale (MBS) and Pittsburgh Sleep Quality Index (PSQI) of the all participants were calculated. Training with relaxation exercises were given to 37 COPD patients who were determined as the intervention group. The control group had training for only breathing exercises.

Relaxing Exercises

Content of relaxation exercises was formed as lower extremity exercises, upper extremity exercises and breathing exercises. The appropriate number and set of repetitions of each exercise were adjusted to the patient. The continuation of the exercise program was ensured for about 30 minutes a day and for 6 weeks. Lower extremity exercises consisted of ankle pumping exercise and bedside knee flexion-extension exercises. In the ankle pumping exercise performed to control the circulation and prepare the patient for the exercise program, the individual was arranged to breathe while pulling his foot towards himself (dorsiflexion) and to exhale while pushing his foot (plantar flexion). Similarly, in the bedside knee flexion-extension exercise, he was shown to inhale while bending the knee (flexion) and exhale while straightening the knee (extension). Upper extremity exercises consisted of shoulder abduction, shoulder flexion and circumduction movements to be performed with breath control. The degree of joint range of motion was determined according to the patient, and he was taught to breathe in each exercise in which the rib cage expanded and to exhale while relaxing.

Breathing Exercises

Breathing exercises were composed of pursed-lip breathing, thoracic expansion exercises, and diaphragmatic breathing components. For pursed lip breathing, the patient was taught to breathe deeply through the nose and exhale through the mouth. Training was given for respiratory control so that the exhalation time was twice the inhalation time. Thoracic expansion exercises were given to help the patient's lung segment especially needed to be ventilated. For diaphragmatic breathing exercises, in order to stimulate deep breathing and increase breathing volume, the patients were asked to put their hands on their stomach while they were in the supine position and inflate the bottom of their hands with the breath they took through their noses.

Exercise trainings were given practically for 30 minutes in a quiet room by a physiotherapist. Illustrated hand brochures explaining the exercises were distributed to the patients at the end of the education. They were asked to take notes of the time of daily exercise for both groups. All of the participants were called two weeks after the initial training. They were asked whether they did the exercises correctly and whether they repeated each day. Those who exercised for about 20-30 minutes

every day were considered to be fully compatible with the program. Those who exercised for less than 20 minutes, not less than 5 days a week, were considered as partially compliant. Those who exercised less than 5 days a week and for less than 20 minutes were considered as non-compliant with the program. Two patients in the intervention group left the study due to hospitalization with COPD exacerbation. One patient was excluded from the intervention group because of newly diagnosed neurological disorder. Two patients in the control group left the study because one of them was admitted to the intensive care unit due to COPD exacerbation and the other one did not want to be followed up. Thirty four patients in the intervention group, thirty three patients in the control group completed the research process. At the end of six weeks, patients in both groups were called to the clinic for the application of spirometry, SpO_2 measurement, mMRC, MBS and PSQI scales as a post-test. Data were collected by the researcher through face-to-face interviews. Each interview lasted approximately 25-30 minutes for a single patient.

Statistical analyzes and figures were performed with "Jamovi project (2020), Jamovi (Version 1.1.9.0) with [Computer Software] (Retrieved from https://www.jamovi.org). The significance level was taken into account as 0.05 (p-value) in statistical analyzes. Descriptive statistics were shown as mean ± standard deviation and median values. Categorical variables were summarized as a percentage. Independent Samples t-test was used in two independent group comparisons if it showed normal distribution. In other cases, the Mann Whitney U test was used if it did not show normal distribution. Changes between two measurement values taken from the same individuals were evaluated with Paired Samples t-test when numerical variables showed normal distribution. Wilcoxon test was used in cases where it did not show normal distribution. Differences between categorical variables were compared in 2x2 tables with Pearson Chi-Square and Fisher's Exact Test. The relationship between numerical variables were examined with Spearman's Rho Correlation coefficient.

RESULTS

A total of 67 patients completed the study. Sixty five (97%) were male and two (3%) were female. The mean age was 68.5±8.3 years. The general demographic data of the groups were summarized in **Table 1**. There was no significant demographic difference between the groups. It was determined that there was a statistically significant difference in smoking status between the groups (p=0.027). There was not any statistically significant difference in the comparison of some other clinical data of individuals. **Table 2** includes the smoking status, comorbidities and some clinical data of the individuals included in the study. The mMRC and MBS scores of the intervention group after six weeks of training with relaxing exercises were lower than the control group. The decrease in the post mMRC score and the increase in the post SpO2 were significant in the intervention group. The changes in FEV1 (%), FVC (%), SpO2 (%), mMRC and MBS scores summerized in **Table 3**. The post total PSQI, sleep quality and daytime dysfunction scores were significantly low in the intervention group (**Table 4**). The changes in sleep latency, sleep duration and sleep efficiency scores were significant after training with relaxing exercises (**Table 4**). It was seen that there was a statistically significant, linear, same-sided and moderate relationship between the pre-test PSQI scores and MBS values (rho=0.423 p<0.001) while there was a weak correlation between the pre-test PSQI scores and mMRC values (rho=0.308 p=0.011). A statistically significant, linear, same-directional and moderate correlation was found between post-test PSQI scores, mMRC and MBS values (p<0.001 for each and rho=0.454, rho=0.517, respectively). In other words, it can be said that as the pretest and posttest PSQI scores increased, the mMRC and MBS values also increased. It was observed that there was no statistically significant and linear relationship between disease duration (years) of the individuals and the pretest and posttest values of mMRC, MBS and PSQI (p>0.05 for each). There was no statistically significant difference between the mMRC and MBS mean scores of individuals with and without comorbidity (p>0.05 for each).

Table 1. Demographic data of the participants

	Group		p
	Intervention	Control	
Age, years	69.6±8	67.3±8.5	0.267***
Gender, n (%)			0.999**
Female	1 (2.9)	1 (3)	
Male	33 (97.1)	32 (97)	
Education, n (%)			0.186**
Primary school	28 (82.4)	26 (78.8)	
Secondary school	0 (0)	4 (12.1)	
High School	3 (8.8)	2 (6.1)	
University	3 (8.8)	1 (3)	
Income rate, n (%)			0.375*
Low	18 (52.9)	21 (63.6)	
Intermediate	16 (47.1)	12 (36.4)	
Living place, n (%)			0.664*
City	22 (64.7)	23 (69.7)	
Urban	12 (35.3)	10 (30.3)	
Living conditions, n (%)			0.512**
Alone	4 (11.8)	6 (18.2)	
Family	30 (88.2)	27 (81.8)	

* Pearson Chi-Square test, ** Fisher's Exact test, *** Mann-Whitney U test

Table 2. Clinical data of the participants

	Group		p
	Intervention	Control	
Smoking status, n (%)			0.027[b]
Smoker	4 (11.8)	12 (36.4)	
Non-smoker	1 (2.9)	2 (6.1)	
Ex-smoker	29 (85.3)	19 (57.6)	
Cigarette pack/year [IQR]	43.5 [38-60]	50 [40-55]	0.849[c]
Comorbidity, n (%)	13 (38.2)	9 (27.3)	0.339[a]
Hypertension, n (%)	12 (35.3)	8 (24.2)	0.323[a]
Diabetes, n (%)	2 (5.9)	3 (9.1)	0.673[b]
CAD, n (%)	8 (23.5)	4 (12.1)	0.223[a]
Dyslipidemia, n (%)	8 (23.5)	4 (12.1)	0.223[a]
Heart failure, n (%)	0 (0)	3 (9.1)	0.114[b]
COPD duration (year)	6 [2-10]	7 [5-10]	0.645[c]
LTOT, n (%)			0.548[a]
Yes	11 (32.4)	13 (39.4)	
No	23 (67.6)	20 (60.6)	
NIV, n (%)			0.803[a]
Yes	7 (20.6)	6 (18.2)	
No	27 (79.4)	27 (81.8)	
Annual exacerbation [IQR]	1.5 [1-5]	2 [1-3]	0.573[c]
Treatment, n (%)			0.201[b]
LAMA	7 (20.6)	2 (6.1)	
LAMA+LABA	3 (8.8)	6 (18.2)	
LABA+ ICS	3 (8.8)	1 (3)	
LAMA+LABA+ICS	21 (61.8)	24 (72.7)	

[a] Pearson Chi-Square test, [b] Fisher's Exact test, [c] Mann-Whitney U test, IQR: Interquartile Range, CAD: Coronary artery disease, LTOT: Long-term oxygen therapy, NIV: Non-invasive mechanical ventilation

Table 3. Comparision of pre and post-test values of FEV1, FVC, mMRC, MBS and SpO2

	Group		p
	Intervention	Control	
FEV1 (%)			
Pre test	40.5 [28-54]	35 [28-45]	0.444 a
Post test	38.5 [27-51]	32 [29-41]	0.324 a
px	0.623	0.458	
FVC (%)			
Pre test	58±15.9	55.9±18.6	0.613 b
Post test	55.9±13.9	54±19.8	0.645
p z	0.285	0.222	
mMRC			
Pre test	2.5 [2-3]	2 [2-3]	0.628 a
Post test	2 [1-3]	2 [2-3]	0.016a
p x	<0.001	0.564	
MBS			
Pre test	5 [4-7]	6 [5-7]	0.533 a
Post test	4 [3-5]	5 [5-6]	0.010a
p x	<0.001	0.029	
SpO2 (%)			
Pre test	91.9±4	92.3±2.6	0.612 b
Post test	92.9±3.6	92.3±3	0.458 b
p z	0.023	0.929	

Descriptive statistics, depending on the distribution; numerical variables were given as mean±SD or median [IQR], x, z: Comparison between repeated measures within group, a, b: Comparison between groups,a: Mann-Whitney U test, b: Independent Samples T test, x: Wilcoxon test, z: Paired Samples T test, IQR: Interquartile Range

Tablo 4. PSQI scores of the groups

	Group		p[a]
	Intervention	Control	
PSQI total			
Pre test	9 [5-12]	8 [5-12]	0.743
Post test	6 [3-8]	8 [5-11]	0.015
px	<0.001	0.024	
Sleep quality			
Pre test	1 [1-2]	1 [1-2]	0.180
Post test	1 [1-1]	1 [1-2]	<0.001
px	0.001	0.058	
Sleep latency			
Pre test	1 [0-2]	2 [1-3]	0.091
Post test	1 [0-2]	2 [1-2]	0.054
px	0.029	0.166	
Sleep duration			
Pre test	1 [1-3]	1 [1-3]	0.963
Post test	1 [0-2]	1 [1-2]	0.057
px	0.001	0.197	
Sleep efficiency			
Pre test	1 [0-3]	1 [0-2]	0.865
Post test	1 [0-1]	1 [0-1]	0.573
px	0.047	0.079	
Sleep disturbances			
Pre test	1,5 [1-2]	2 [1-2]	0.727
Post test	1 [1-2]	2 [1-2]	0.069
px	0.132	0.480	
Use of sleeping medications			
Pre test	0 [0-0]	0 [0-0]	0.200
Post test	0 [0-0]	0 [0-0]	0.344
px	0.414	0.999	
Daytime dysfunction			
Pre test	1 [0-1]	1 [0-2]	0.664
Post test	0,5 [0-1]	1 [0-2]	0.034
px	<0.001	0.480	

x: Wilcoxon test (Comparison between repeated measures within group), a: Mann-Whitney U test (Comparison between groups)
IQR: Interquartile Range

DISCUSSION

This study shows that, after the exercise training given by a physiotherapist, the relaxation exercises applied at home for 30 minutes at a time, every day for six weeks, are effective in reducing dyspnea and increasing sleep quality in COPD patients with high dyspnea score.

Cigarette smoking is the most important risk factor for the development of COPD. Smoking worsens the health status of patients, increases the severity of dyspnea and adversely affects their quality of life. Several studies have shown that increasing the amount and duration of smoking increases the severity of dyspnea in individuals with COPD (9-11). It was determined that the patients with high dyspnea severity had an average of 48.3±22.7 pack/year of cigarette smoking in our study. However, the patients were not similarly distributed in the two groups in terms of smoking. This

is one of the limitations of our study. Therefore, based on our study, it is not possible to comment on the effects of smoking and relaxation exercises on dyspnea and sleep quality. Dyspnea is the most common symptom in patients with COPD and causes the individual to consult a physician. Dyspnea is usually chronic and has a progressive course. Studies have shown an increase in the severity of the disease and an increase in the perception of dyspnea symptoms in COPD patients (12,13). We included the COPD patients with high dyspnea scores in our study. In our study, MBS and mMRC scales were used to evaluate the severity of dyspnea. Our results show that relaxation exercises significantly reduce the dyspnea symptom perception of individuals after a 6-week exercise program. Yılmaz et al. (14) found a statistically significant improvement in post-test mMRC and SpO2 values in 68 patients with moderate and severe COPD who practiced relaxation exercises. In our study, mMRC and MBS were used to evaluate the severity of dyspnea. There was a significant decrease in mMRC and MBS post-test medians in the intervention group. In addition, a significant increase was observed in the post-test SpO2 of the individuals in the relaxation exercise group. It has been shown that the severity of dyspnea assessed by MBS was related to respiratory rate and pulmonary function tests (15). However, we could not find an increase in FEV1% of the patients because of the small number of patients in our study. This may be an other limitation of our study.

Comorbidities have a significant influence on the dyspnea severity, morbidity and mortality in patients with COPD (9). In our study, it was observed that the dyspnea severity of our patients with COPD was not adversely affected by comorbid diseases.

It is thought that respiratory changes seen during sleep in healthy adults may be more severe in individuals with COPD. In COPD, respiratory control center activity decreases and there is an increase in upper airway resistance and serious deterioration in gas exchanges. These changes those lead to severe hypoxemia and hypercapnia are more common in the REM period (16-18). Decreased muscle contractility and diaphragmatic dysfunction seen during the daytime in individuals with COPD become more pronounced during sleep (19). The severity of COPD symptoms increases the likelihood of patients experiencing sleep problems at the same rate (20). More severe nocturnal desaturations are seen in COPD patients with daytime hypoxemia and an FEV1/FVC below 60% (16). In individuals with COPD, total sleep time decreases, sleep efficiency decreases, sleep latency increases, and REM sleep decreases (18). As a result, sleep quality decreases.

In a randomized controlled clinical study (21) which investigated the effect of relaxation exercises during 8 weeks on fatigue and sleep quality in COPD patients, there was not reported any significant difference between the mean pretest and posttest PSQI global scores of the intervention and control groups. However, subjective sleep quality, sleep latency, sleep duration and sleep efficiency sub-components of PSQI were found to be significantly different between the groups. In our study, the difference between the post-test median scores of the global PSQI score, subjective sleep quality, sleep latency, sleep duration, sleep efficiency, and daytime dysfunction between the groups were found to be statistically significant. Şahin et al. (22) reported similar results to our study in the study they conducted with 45 COPD patients in a single group for 6 weeks. Our study, like previous studies investigating the effect of relaxation exercises in individuals with COPD, was carried out with individuals with COPD in a stable period (14,21,22). Future studies may be planned with COPD patients in the exacerbation episode.

CONCLUSION

Relaxation exercises can be used as a non-pharmacological treatment method in addition to pharmacological treatments in patients with advanced stage and high symptom perception. There is a need for studies examining the effects of relaxation exercises on dyspnea and sleep quality in individuals with COPD in exacerbation. The use of telemedicine methods to evaluate patients' compliance with the relaxation exercise program and to facilitate their follow-up may be determined for future studies.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Muğla University Medical Faculty Clinical Researches Ethics Committee (Date: 05.09.2019, Decision No: 11/VI).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: No conflict of interest was declared by the author

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Author Contributions: The author declares that he has responsible for the design, execution, and analysis of the paper and that he has approved the final version.

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